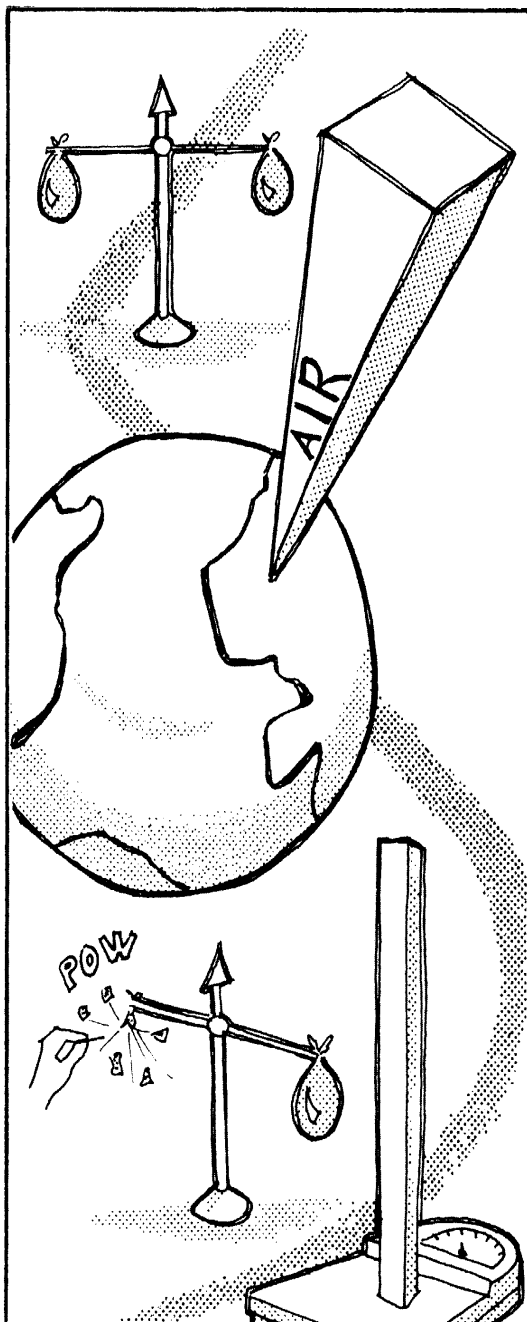
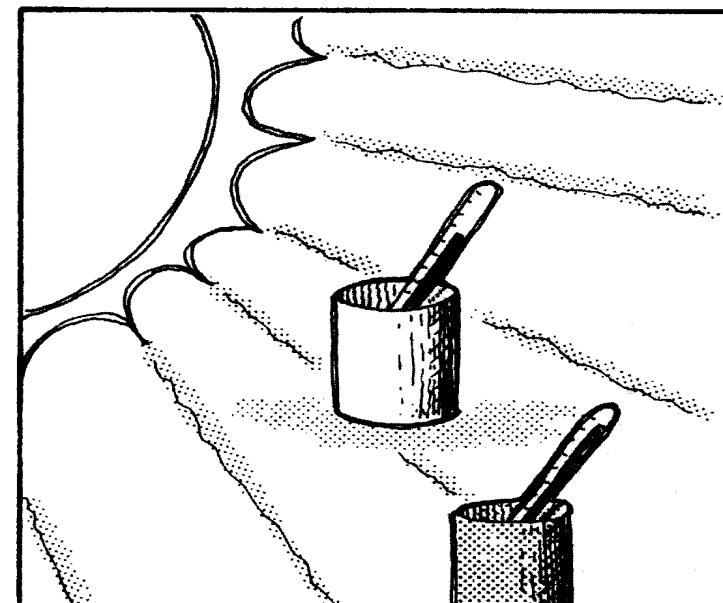
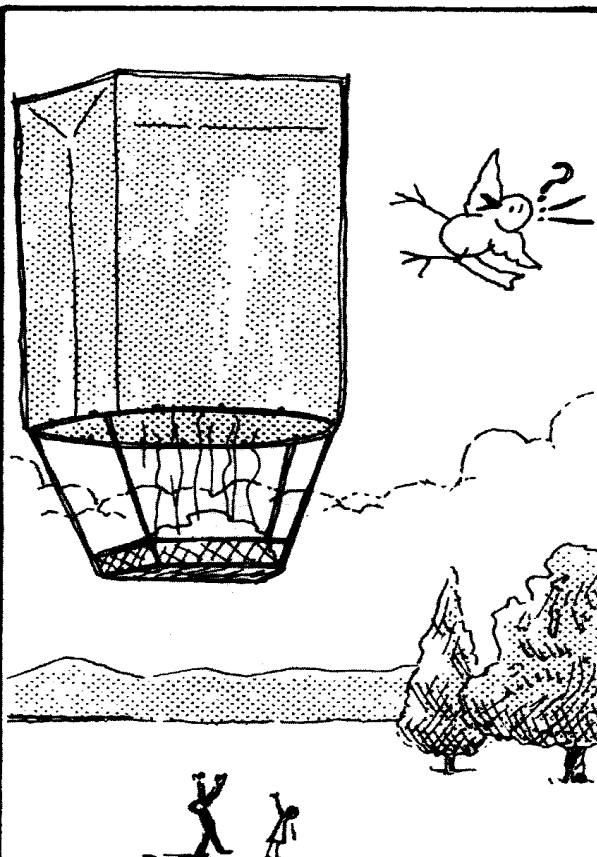
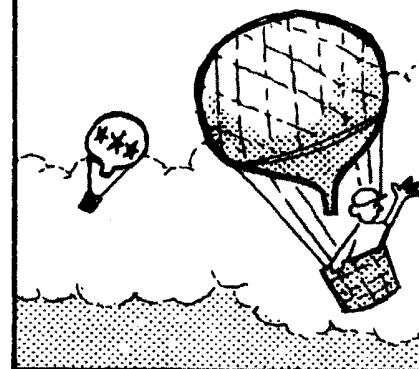


DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

AVIATION

EDUCATION



TEACHER'S INFORMATION

Demonstration Aids for Aviation Education- Volume 11 is a series of simple, concrete revealing experiments developed by the Civil Air Patrol Center for Aerospace Education Development for the Federal Aviation Administration specifically for upper elementary grades. These activities can be adapted to meet the needs of varied teaching situations and different grade levels.

These materials are primarily designed as pupil directed experiences. In some instances the teacher may want to further extend the investigations. This series is intended to be a springboard for your own ideas to demonstrate concepts of the Air Age to your students. Young children can learn scientific principles through simple learning activities; older students can benefit it from a review using the same activities.

The purpose of this series is to illustrate certain principles related to various concepts of aviation and space. More important, it is an opportunity for you to directly involve students in investigations and in making discoveries on their own.

You needn't be an "expert" in science to use this material. In fact, you shouldn't be expected to have all the correct answers to the questions presented in the material. Moreover, many of the activities are designed to include interdisciplinary skills and need not be used in sequence.

Each packet in the series forms a coherent program of instruction on a single topic: Nonpowered Flight, Aerospace and the Environment, Space Exploration and Communications. Most of the tasks are introduced as a question. In order to answer the question, the students may want to first predict the solution. Then have them follow the activity instructions to arrive at an answer. This kind of student involvement may lead to other related questions generated by the teacher, other students, or suggested on the cards themselves.

Most of the activities utilize materials readily available from any given community and can be completed in the classroom. Others may require that you borrow some equipment from your science resource center or from a junior or senior high school in your district.

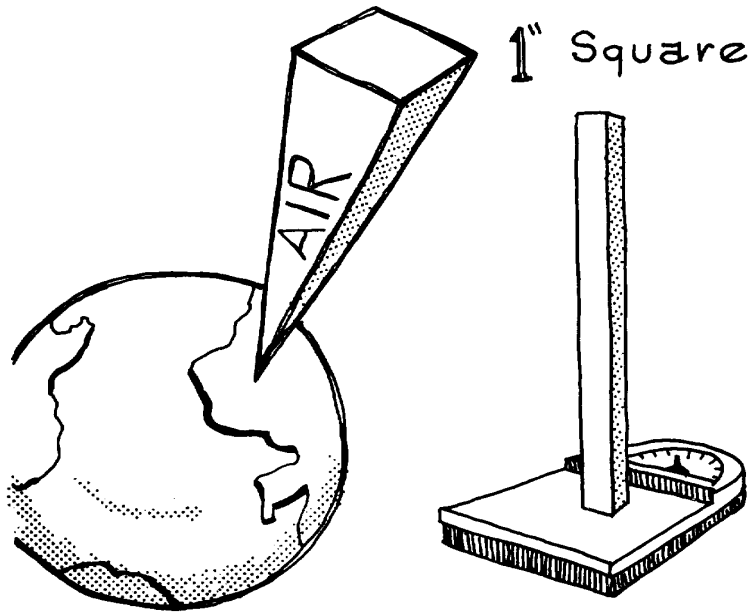
Please let us know your reactions to the materials and feel free to ask for more information related to aviation or space. We wish you success and many enjoyable experiences as you use these packets.

Written by Ms Debbie Williams and Ms Carol Hickson
Editorial Assistance by Mrs. Patricia Smithson
Illustrated by Mr. Harley A. Samford

DOES AIR HAVE WEIGHT?

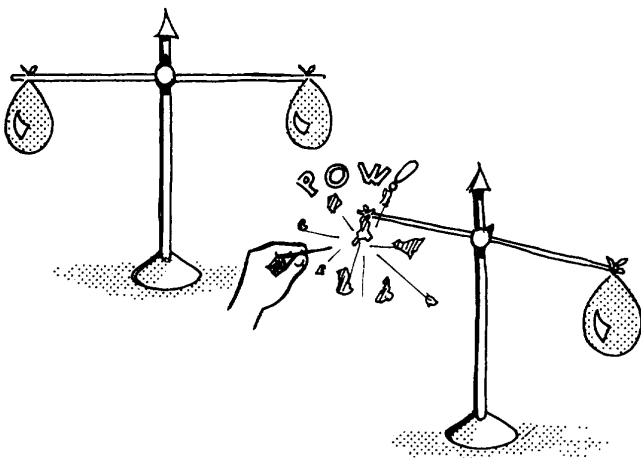
LA-1

The air envelope around the earth extends about 500 miles above us. It is made of very tiny molecules barely measurable. One column of air, one square inch from earth to outer space weighs about 15 pounds.



MATERIALS:
Balance
2 inflated balloons
Pin

Balance two inflated balloons on the scale. Pop one of them with a pin. When the air leaves the broken balloon, it weighs less and rises.

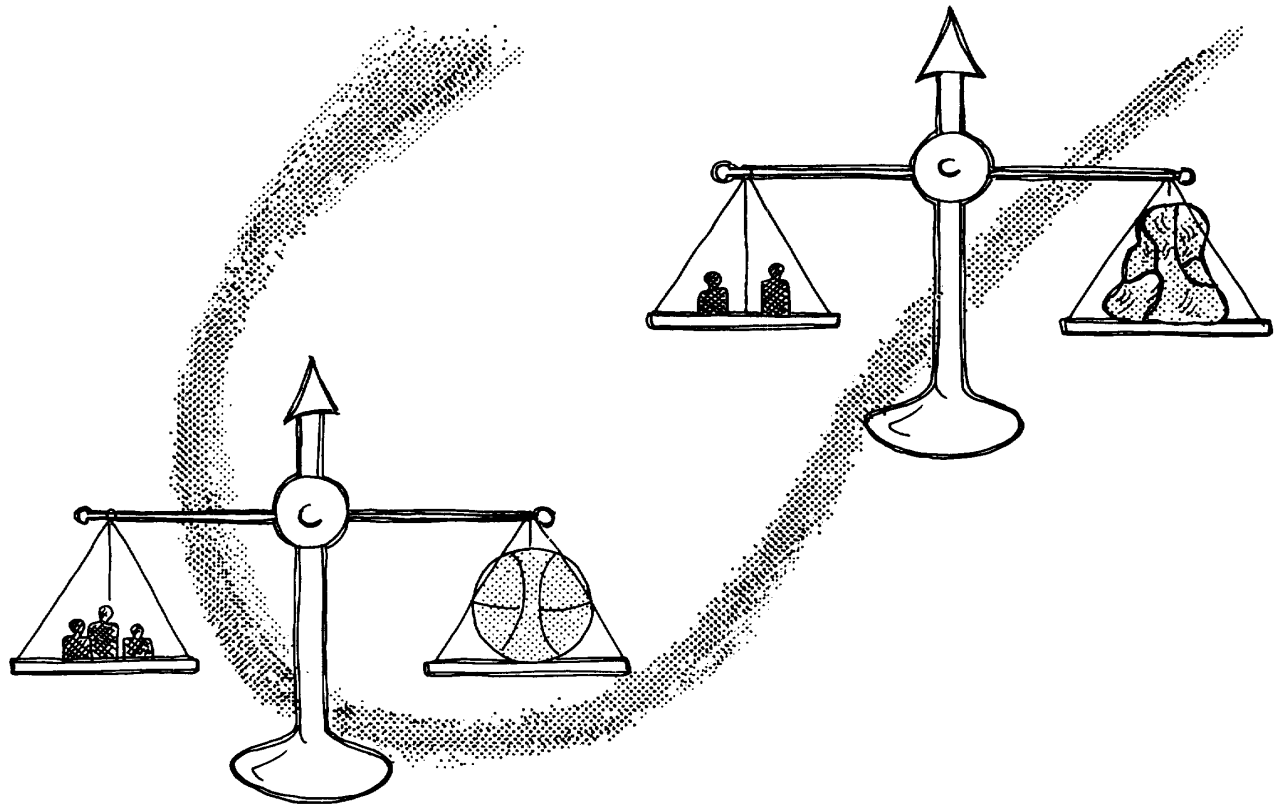


WHICH IS HEAVIER, AN INFLATED BASKETBALL OR A DEFLATED ONE?

LA-2

MATERIALS:
Basketball (inflated)
Scale Weights

Weigh an inflated basketball. Record the weight.
Remove the air from the ball. Weigh it again.
Compare the weights.



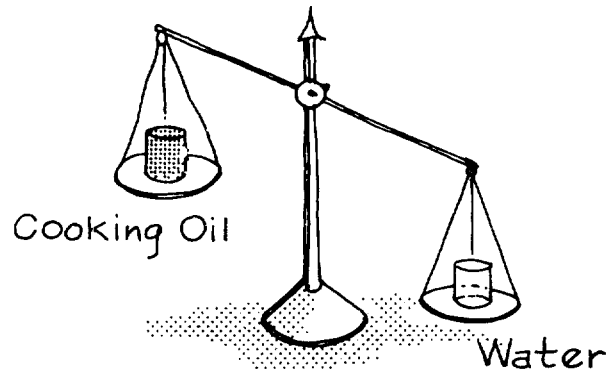
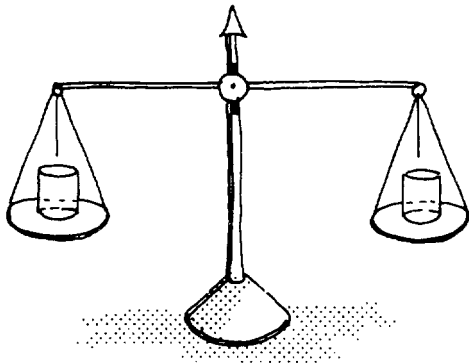
Blimps, balloons, and other lighter-than-air craft fly because they are lighter than air surrounding them. They float upward like a hollow ball floats to the top of water.

EXPERIMENT:



MATERIALS:

Balance Cooking oil
Water
2 Containers of equal weight



Balance the two containers on the scale. Add equal amounts of water and cooking oil to each container. The amount is not important. One drop of water will always be heavier than one drop of cooking oil because water is heavier than cooking oil.

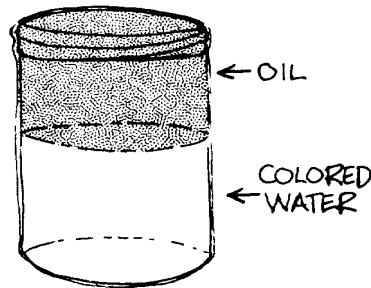
Now that we have established that water weighs more than cooking oil, let's try something else. What happens if we mix the two?

MATERIALS:

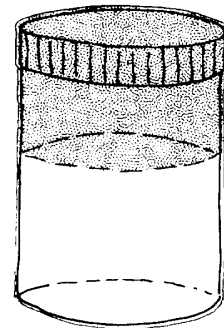
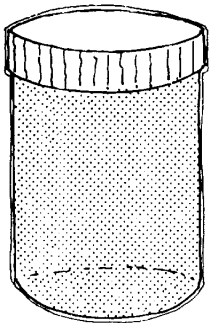
Jar & lid Cooking oil
Water Food coloring

Fill the jar half way with Cooking oil. Add colored water until it is

to the top. What happens? Now put the lid on the jar and shake it for about 10 seconds. Let it stand for several minutes. What is happening?



Look at it again in 30 minutes. Why is it back to its original condition?



Oil is pushed upward because it is lighter than water. Air will push a lighter substance upward in a similar way. Hot air is one of these lighter substances.

IT'S FULL OF HOT AIR!

LA-5

This activity should be done only with the supervision of the teacher or other designated adult.

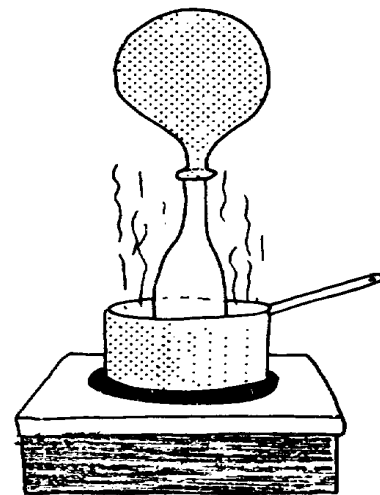
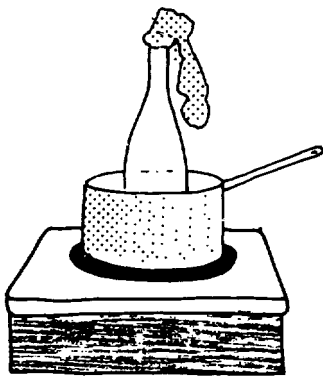
Hot air is light because the molecules of air move faster when heated. Water molecules also move faster when heated. You can see the results of heated water as you watch it boil. As air molecules "boil" or move rapidly, they spread out and are fewer in a given area.

MATERIALS:

Hot plate	Balloon
Pop bottle	Water
Sauce pan	

Put some water in a sauce pan and place it on the hot plate. Put the balloon over the top of the pop bottle and place the bottle in the water. Heat the water. As the air molecules in the

bottle warm, they begin to spread out and fill the balloon. There are fewer air molecules left in the bottle so air in the bottle weighs less than it did before it was heated.



WHAT HAPPENS WHEN AIR IS HEATED?

LA-6

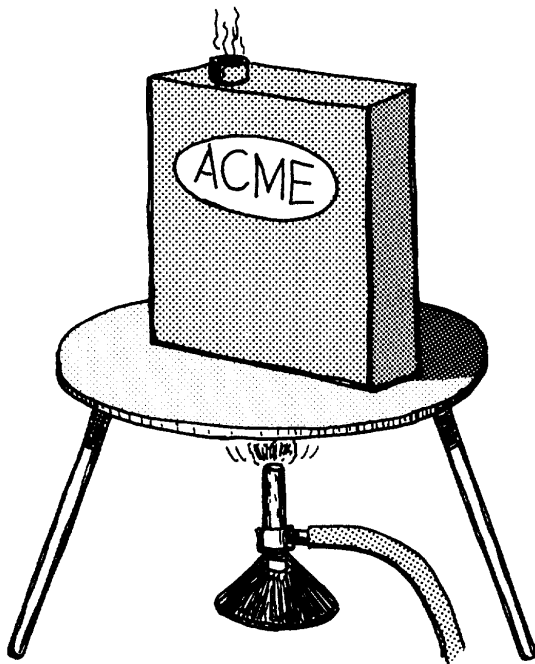
This activity should be done only with the supervision of the teacher or other designated adult.

MATERIALS:
Four sided can
Water
Heat source

Put a small amount
of water in a can.

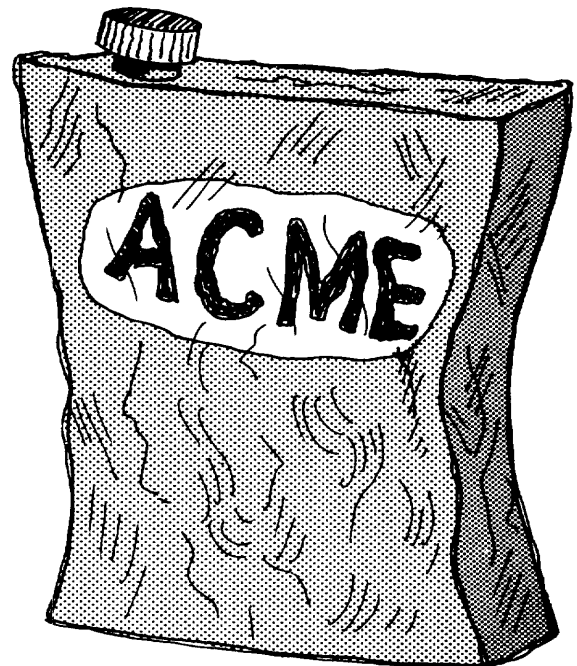
Heat the water until
it boils and steam from the
boiling water drives the air out
of the can. Allow the water to
boil for a few minutes.

Remove the heat source and
screw the lid on the can tightly.



Watch the can . . .

Why does this happen?



WHERE DOES HOT AIR GO?

LA-2

This activity should be done only with the supervision of the teacher or other designated adult.

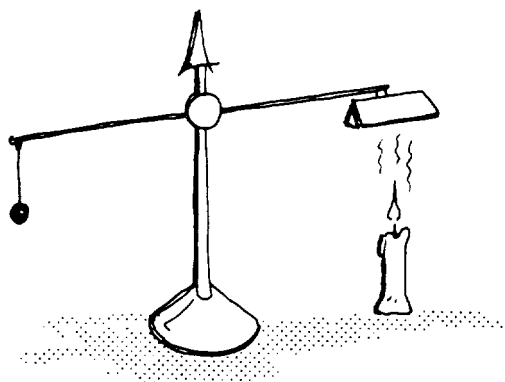
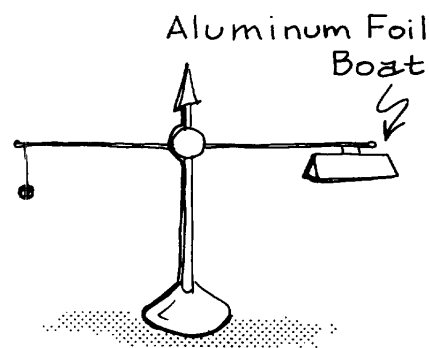
Because hot air is lighter, it is pushed upward by cooler, heavier air. (Remember the oil and water?)

MATERIALS:

Balance Candle
Aluminum foil
Washer (or other light weight)

Make a large hollow shape out of aluminum foil. Attach it to one arm of the scale.

Attach enough weight to the other arm to balance the scale. Hold a candle under the foil.



As the flame heats the air, it becomes lighter and surrounding air will push the hot air and foil upward. Other, gases that are lighter than air are hydrogen and helium.

You can make a hot-air balloon with a controlled heat source.

MATERIALS:

A light paper bag

Cotton balls

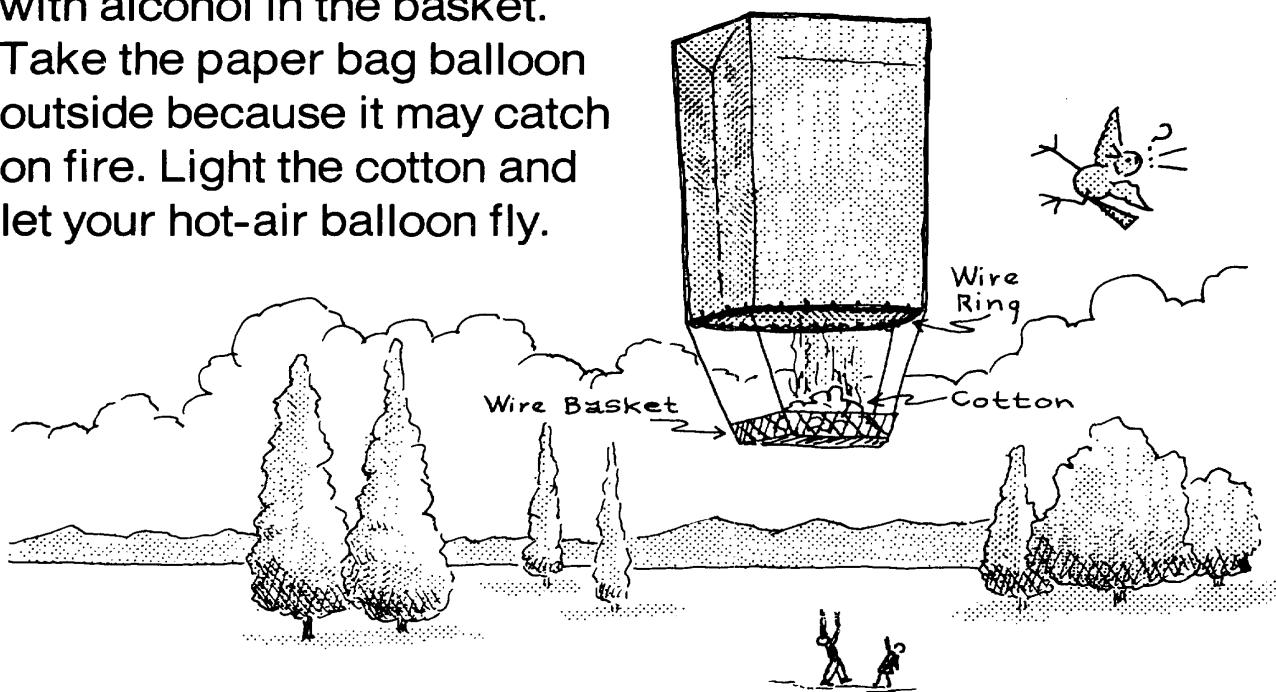
Alcohol

Wire Matches

This activity should be done only with supervision of the teacher or other designated adult.

Try a simple paper bag balloon. First, make a simple basket and ring from lightweight wire. Attach the ring to the mouth of the bag. Place the cotton dampened with alcohol in the basket.

Take the paper bag balloon outside because it may catch on fire. Light the cotton and let your hot-air balloon fly.

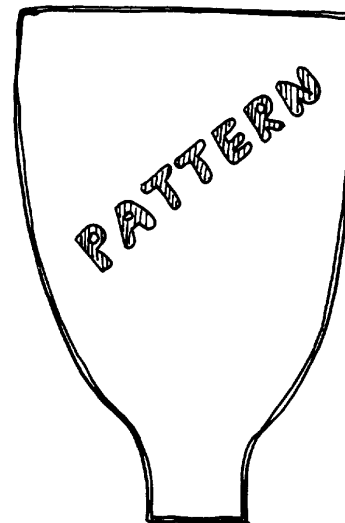


Now let's really get serious about this hot-air balloon business. Let's build a model with a better shape and much better lifting power. In fact you will probably need to attach a kite string so this one will not drift away.

Cut the 6 sheets of tissue paper in the shape of the pattern shown. Overlap the sides of the six sheets paper and secure with rubber cement. Cut and glue a circular piece of tissue paper to the top. Make a wire ring and basket and attach to the mouth of the balloon. Take your balloon outside, dampen the cotton with alcohol, carefully light it and let it go (remember to tie a string to it if you don't want to lose it).

(This activity should be done only with supervision of the teacher or other designated adult.)

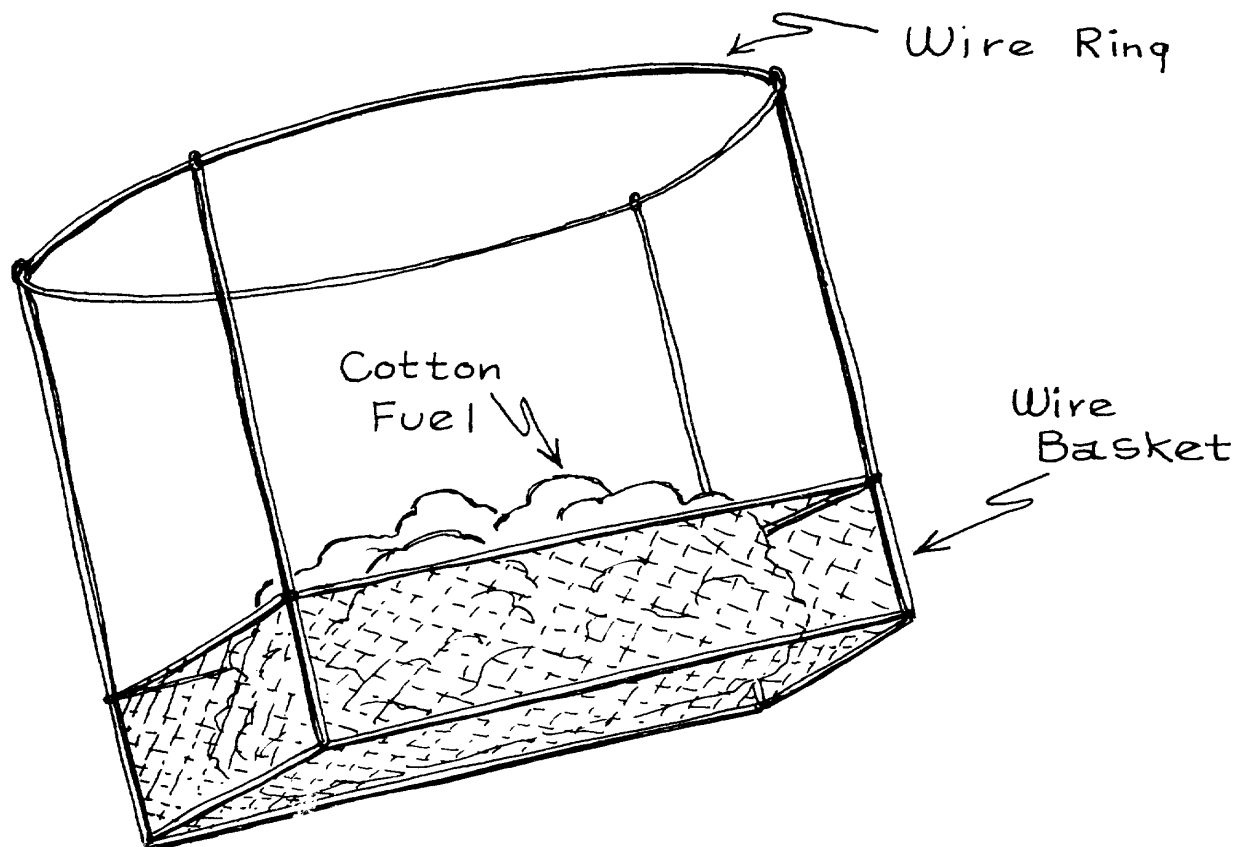
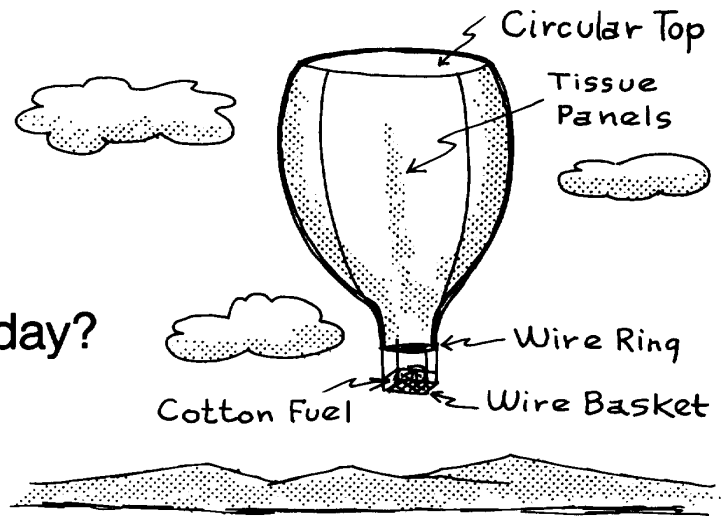
MATERIALS:
6 sheets of thin
tissue paper
Rubber cement
Wire Matches
Cotton
Alcohol



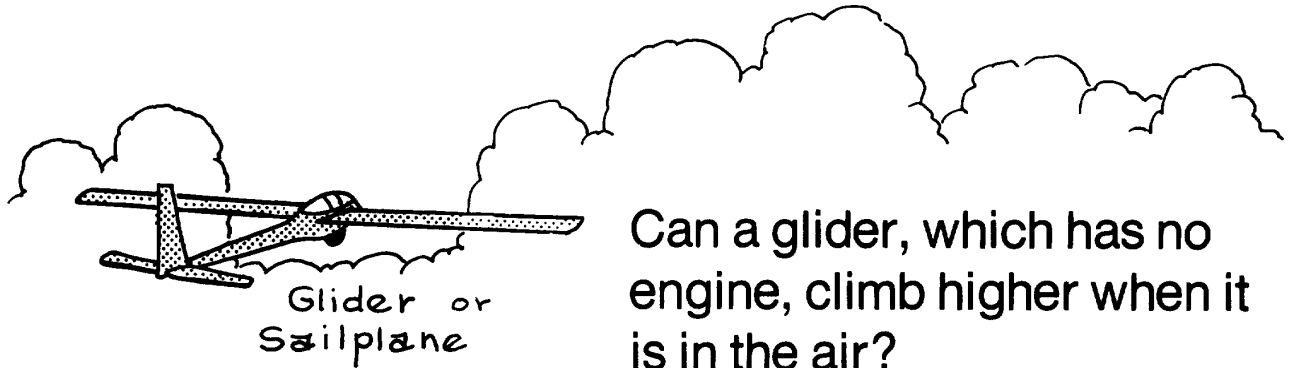
Why does the balloon
rise in the air?

What guides the balloon?

Would the balloon fly
better on a warm or a cold day?

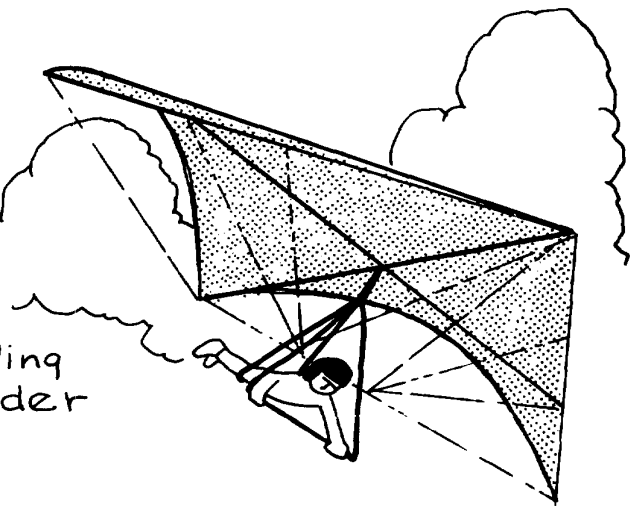


Just as a cork floats on water, warm air floats on top of cold air. This is because the warm air is less dense and lighter than cold air. Can you think of some simple experiments to show that warm air is lighter than cold air?



Can a person hang-gliding move up and down while in flight?

Rogallo Wing
Type Hang Glider

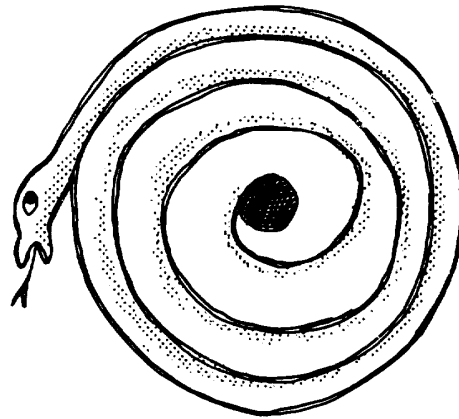


What is a draft? Have you ever felt a cold draft in an old house, or a large theater or restaurant? Why do you usually feel it on your feet?

MATERIALS:

Pencil with eraser
Piece of stiff paper
Thread — Spool
Scissors — Pin
Thimble

You can make a swirly-twirly snake toy that moves when it is warmed up. On the stiff paper, draw a spiraling snake. Make your snake large enough that a thimble will pass through

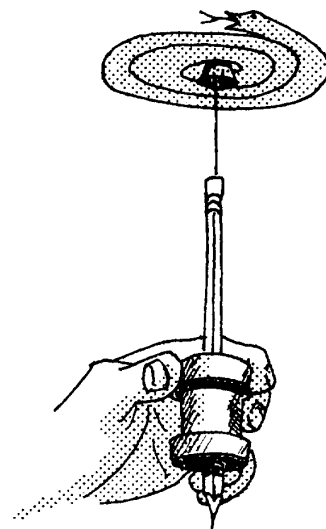


the dark circle at the center (as shown in the drawing). Cut out along the lines. Put the pencil in the spool and the pin in the eraser.

Put the thimble through the dark circle at the center of the snake, then put the thimble and the snake on the pin. Hold the toy over a radiator, heater, candle or mantle piece.

What happens? Why?.

Can you use this toy to help explain the movements of the glider and the hang glider?



Try making this soap-bubble balloon.

MATERIALS:

Soap flakes (Ivory, etc.)

Water — Paper disc

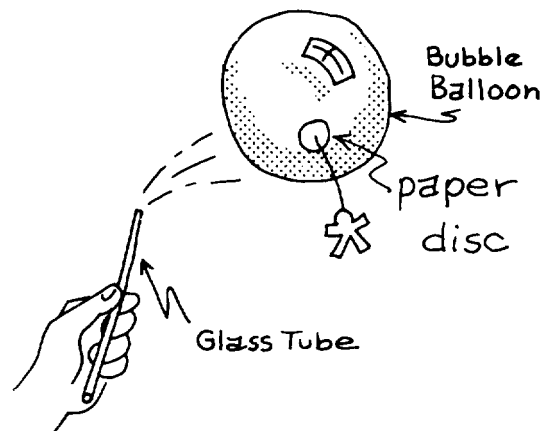
Glycerine — Thread

Tissue paper

9" glass tube or straw

Make a stiff lather of soap flakes and water. Add a little glycerine. Make a tissue paper balloonist about 1" high and glue him by a 1 1/2" thread to a paper disc. Take your

materials into a cold room or outside. Dip the tube or straw into the soap solution and blow steadily until a perfect bubble forms. Drop the dry paper disc onto the bubble. As soon as the disc is firmly fixed, carefully turn the tube upward,



and the balloon will fly away.

Why is it important to do this experiment in a cold place? How does your breath compare in temperature with your surroundings?

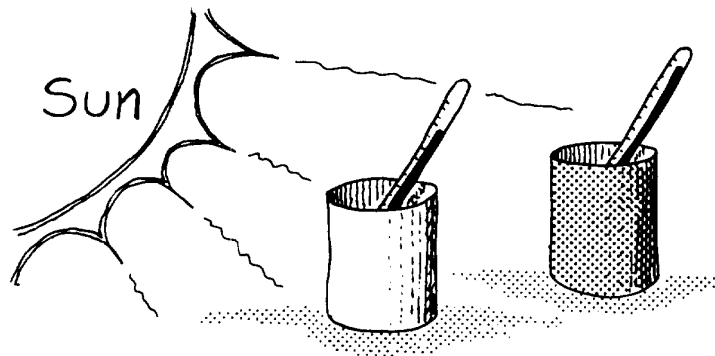
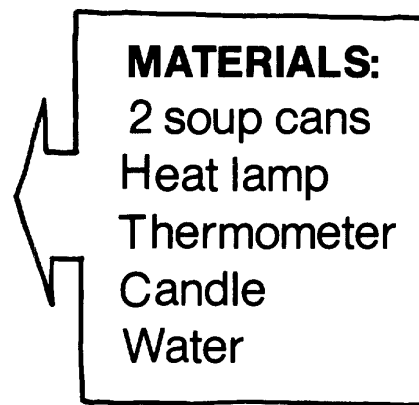
HOW CAN YOU CONTROL TEMPERATURE IN A BALLOON?

LA-1E

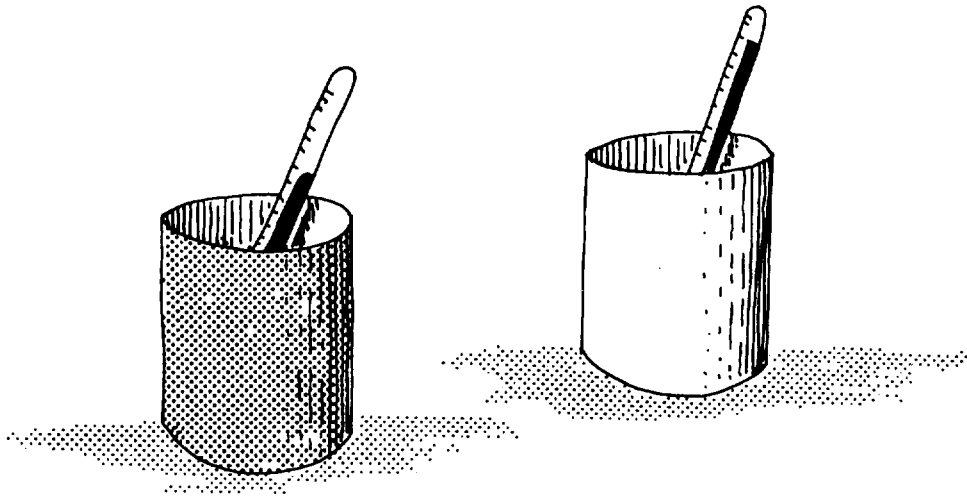
Some people believe that the higher we go, the warmer it gets because we are closer to the Sun. This is not true. The Sun is 93 million miles away! 100 miles or so closer does not make much difference. Altitude and temperature are not related.

This may help you understand why.

Remove the lid and label from each can. Use carbon from the candle to blacken one of them. both cans with cool water. Place them over a warm radiator, in warm sunlight, or in front of a heat lamp. After 15 minutes measure the temperature of both. The water in the dark can is warmer than the water in the silvery can.



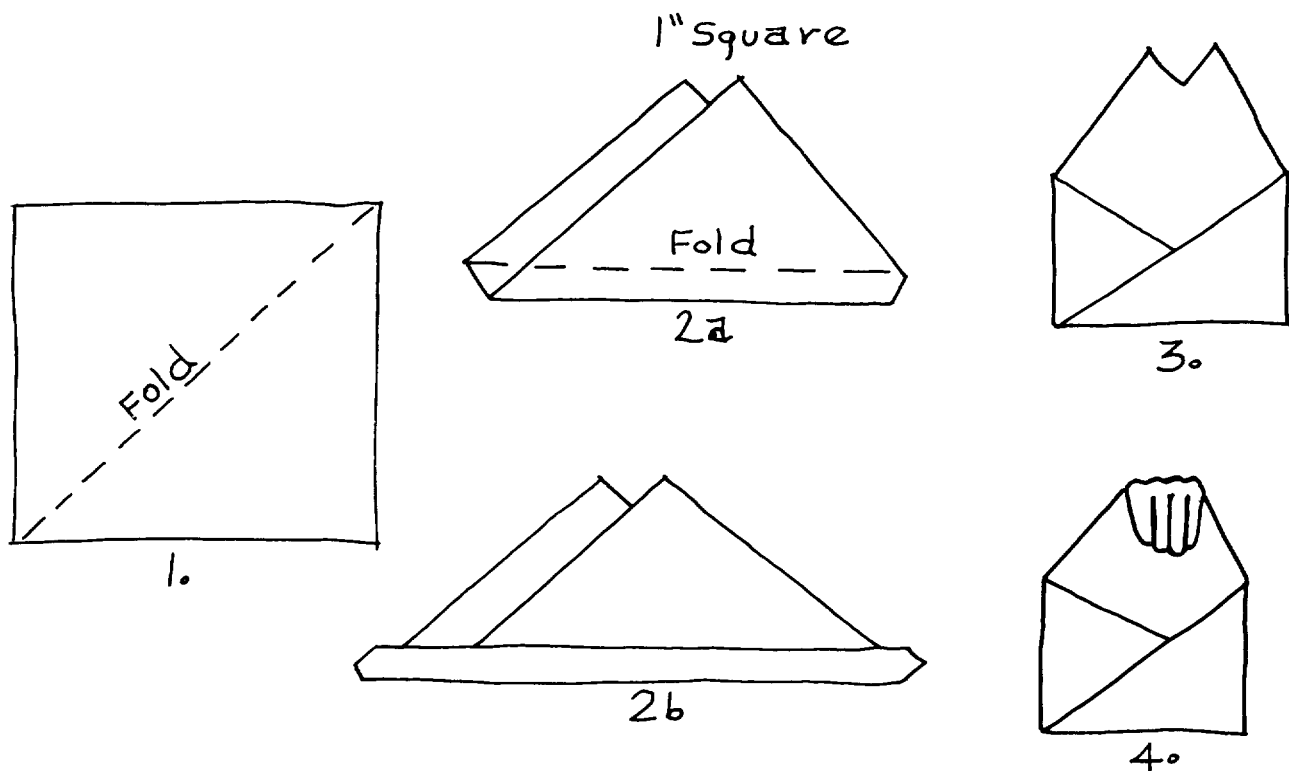
Put the same two cans in a protected place away from air drafts. Fill them both with hot water (not boiling). Measure the temperature 15 minutes later. This time the water in the dark can is cooler than the water in the silvery can.



In the first experiment the dark-, can absorbed more heat than the bright one. In the second experiment the dark can lost more heat than the bright one. So, you can see that material that is a good absorber of heat also loses heat rapidly.

There are many things that can fly, glide and ride the wind because of their special shape and light weight.

Try this paper air foil.

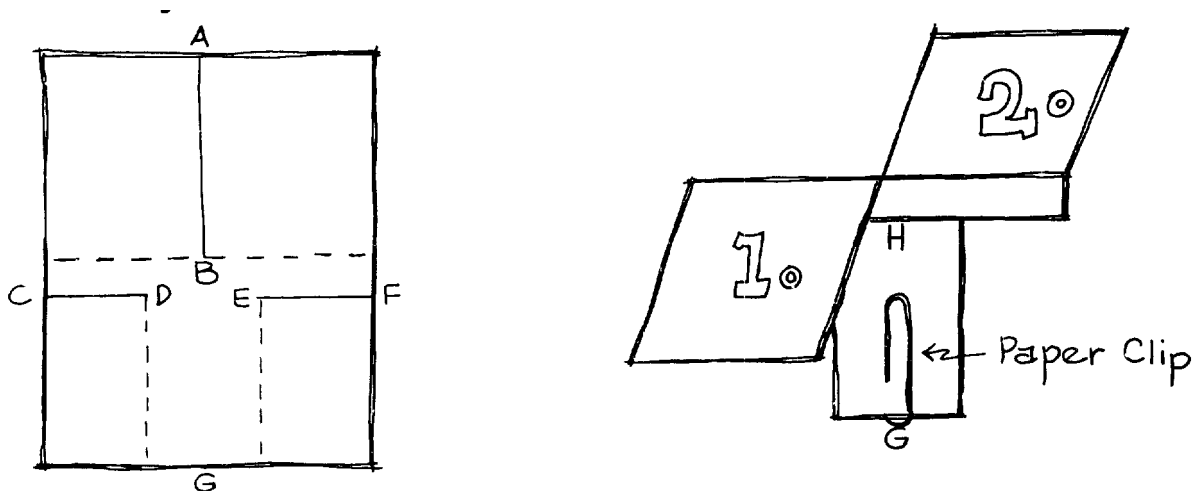


1. Fold paper diagonally so that upper edges leave about 1 " square space.
- 2a-2b. Fold bottom edge up about 1 ".
3. Bring outside edges together, tucking one inside the other.
4. To fly the air foil, pick up in the manner suggested in the diagram. Hold over head and throw as if throwing a baseball overhanded . . . Then watch it fly!!



Have you ever watched the aerobatics of fall leaves dancing on the wind? Why do some leaves spin? Some float? Some glide? Gather an assortment of leaves and compare their size, shape, and weight. You might make a similar comparison to various seeds that are spread by the wind. How do "floating" seeds differ from other kinds of seeds?

Try this paper helicopter. Does it fly like any of the leaves or seeds you have observed'?



Cut an 8 1/2 x 11 " piece of paper into fourths. Each quarter sheet will make one helicopter. Following the illustration, fold each sheet in half and cut from A to B. Cut from C to D and F to E. Fold F to D and C to E. Paper clip together at G and staple at H. Fold down wings 1 and 2. Hold high, spin, and let go.

MAKE YOUR OWN WINDMILL!

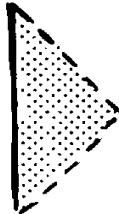
HA-3

MATERIALS:

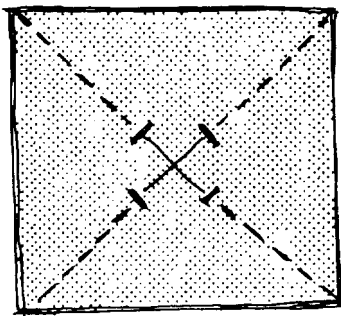
Square sheet of paper
Straight pin
Pencil with eraser
Scissors

Fold the paper diagonally.

Fold it again now,
when you open
the paper and lay it
creased through it.

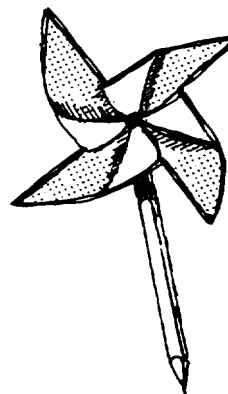


out flat, it will have an x



Cut along each fold to
within one inch of the center.
Pick up one corner
and hold it in the center. Do
this with each of the


other corners. Keep them in the
center by sticking a straight pin
through them, then stick the pin
through the eraser. Move your
windmill through the air and watch
it spin!



MATERIALS:

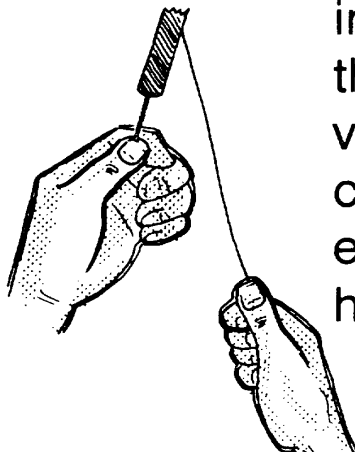
1 soda straw — 1 cup lid
1 coffee stirrer — Thread
1 piece string, 20 " long
Scotch tape

Most of the materials used to make this fun flyer can be collected from the many fast food establishments around.

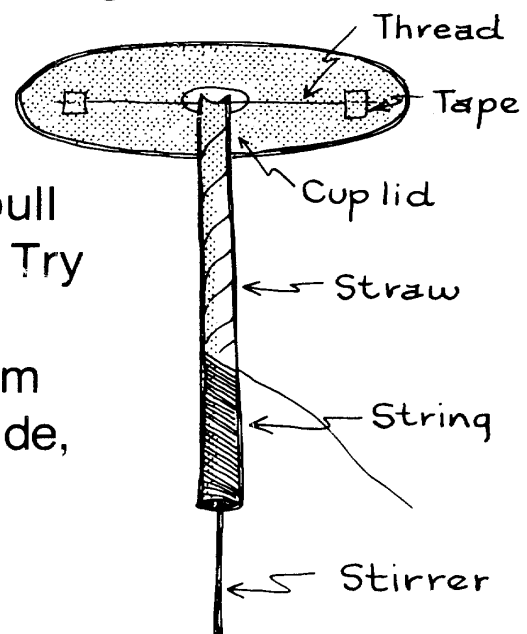
Notch one end of the straw. Tape a piece of thread across the opening in the cup lid. Put  the cup lid on the notched end of the straw, placing the thread in the notches. Insert a coffee stirrer in the other end of the straw. Wind a string around the lower

portion of the straw.

When you are ready to launch, hold the stirrer



in one hand and pull the string rapidly. Try variations of lids, cutting slits in them etc., to change glide, height and so on.



NONPOWERED FLIGHT

- LA-1 DOES AIR HAVE WEIGHT?
- LA-2 WHICH IS HEAVIER?
- LA-3 WHY DO OBJECTS FLOAT?
- LA-4 H₂O HAS IT!
- LA-5 IT'S FULL OF HOT AIR!
- LA-6 WHAT HAPPENS WHEN AIR IS HEATED?
- LA-7 WHERE DOES HOT AIR GO?
- LA-8 IT'S IN THE BAG!
- LA-9 UP, UP, AND AWAY!
- LA-10 WARM UP
- LA-11 BUBBLES UP!
- LA-12 HOW CAN YOU CONTROL TEMPERATURE IN A BALLOON?
- HA-1 RIDE THE WIND
- HA-2 NATURE'S HELICOPTERS.
- HA-3 MAKE YOUR OWN WINDMILL
- HA-4 GYROCOPTER A LA McDONALD'S

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